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UNITED STATES PATENT APPLICATION

FOR

APPARATUS, SYSTEM AND METHOD FOR TRANSFERRING A RUNNING WEB

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Background of the Invention

Modern machinery for processing running webs into paper products, such as tissue and paper toweling, employs a vacuum applied to the running web to adhere the running web to a moving carrier fabric. Several carrier fabrics may coordinate together, and each carrier fabric typically moves in an endless loop. The running web is transferred from one carrier fabric to another carrier fabric during the papermaking process, beginning at a headbox slurry and ending with a finished product of one or more layers.

Historically, flat carrier fabrics have been used to manufacture such products. However, in many modern uncreped through air dried ("UCTAD") tissue making processes, some of the carrier fabrics used are not flat, and include a raised pattern projecting from the fabric surface that includes topographical features.

It is a significant manufacturing challenge to reliably and securely transfer a running web when the fabric employed to carry the running web is not flat. Flat carrier fabrics tend to hold tightly the running web with a minimal amount of vacuum applied to the running web, while a carrier fabric employing topographical features typically requires a greater degree of vacuum pressure to reliably hold the running web in place upon the surface of the carrier fabric. Thus, a need exists to

provide improved methods and apparatus for transferring running webs from one carrier fabric to another carrier fabric, especially for carrier fabrics that employ topographical features.

The amount of vacuum that must be applied to tightly adhere a running web to a moving carrier fabric varies. The vacuum must be great enough to ensure reliable transfer, but not so great as to damage the product. For example, if the level of vacuum is too high, undesirable holes or defects may be formed in the running web. Thus, one significant challenge in the papermaking industry is to regulate the level of vacuum applied to a carrier fabric to ensure a reliable manufacturing process that produces a high quality product.

The apparatus used to transfer a running web from one moving carrier fabric to another is commonly called a "pick up box", or "box." The reservoir or manifold connected to the "box" employing a vacuum is sometimes called a "vacuum box." Vacuum boxes typically have been oriented across the entire width (i.e. cross direction) of a running web. Pick up boxes apply a vacuum force to rapidly and securely pull a running web from a first fabric to a second fabric.

Unfortunately, web transfer difficulty is sometimes experienced near the edges of the running web. That is, the medial portion of the running web may transfer well, but the edges may not transfer reliably to the receiving carrier fabric, which can be a significant problem. This problem may be especially pronounced at low transfer vacuum levels. In

some applications, the problem may occur in part because web edges are not smooth and flat during transfer. Poor edge transfer sometimes causes the running web to strike downstream equipment, such as a through air dryer, causing a web "pile-up", which may result in undesirable production problems.

What is needed in the industry is an apparatus, system and method for transferring a running web among several carrier fabrics in a secure and reliable manner, while avoiding or minimizing damage to the final manufactured product. A transfer that secures the edge of the running web to the receiving carrier fabric without damaging equipment or causing production problems would be highly desirable. An apparatus or method that is capable of performing the transfer at relatively low vacuum levels would be especially desirable.

Summary of the Invention

A vacuum apparatus for a papermaking machine is provided in one embodiment. The papermaking machine provides at least a first and second carrier fabric, said first and second carrier fabrics each having a machine direction and a cross direction perpendicular to the machine direction. In combination, a running web is provided for travel on the apparatus, the running web being adapted to proceed in the machine direction. The running web includes a width in the cross direction, the running web being bounded by a first edge and a second edge. In one aspect of the invention, a primary head is positioned

adjacent to and in fluid communication with the running web. A primary vacuum box may be joined to the primary head, the primary vacuum box having on its interior a first region of reduced air pressure. The primary vacuum box may extend in the cross direction and can be adapted for applying reduced air pressure to the primary head for application to the running web in transferring the web from the first carrier fabric to the second carrier fabric.

A first auxiliary head also may be positioned adjacent to and in fluid communication with the first edge of the running web. Furthermore, an auxiliary vacuum box is joined to said first auxiliary head, the auxiliary vacuum box having an auxiliary region of reduced air pressure, the auxiliary vacuum box extending in the cross direction. The auxiliary vacuum box is adapted for applying reduced air pressure to the first auxiliary head for application to at least the first edge of the running web.

In another aspect of the invention, a second auxiliary head is provided and is adapted for applying reduced air pressure. In some applications, the first auxiliary head is applied to a first edge of the running or carrier fabric, while the second auxiliary head is applied to a second edge of the carrier fabric.

In some embodiments of the invention, there may be one or more auxiliary heads and/or vacuum boxes, without a primary vacuum box. That is, auxiliary vacuum boxes may be applied in essentially any

location where edges of a running web must be stabilized against a carrier fabric.

A system also is provided for transferring a running web from a first carrier fabric to a second carrier fabric. The system includes a running web having a cross direction extending from a first edge to a second edge. The running web is configured for traveling in a machine direction from an upstream end of the manufacturing process to the downstream end of the process. A primary head is positioned adjacent to and in fluid communication with the running web. The primary head includes a primary contact means for application to the running web, the primary contact means extending in the cross direction of the running web. The primary contact means forms a vacuum slot adjacent to the running web.

A primary vacuum box is joined to the primary head, the primary vacuum box having an interior region of reduced air pressure. The primary vacuum box is adapted for applying reduced air pressure to the vacuum slot of the primary contact means for application to the running web to transfer the running web from the first carrier fabric to the second carrier fabric. The first auxiliary head may be positioned downstream from the primary head. The first auxiliary head includes a first auxiliary contact means extending in the cross direction of the running web and in contact with the running web. The first auxiliary head typically is provided adjacent to and in fluid communication with the first edge of the

running web. A first auxiliary vacuum box is joined to the first auxiliary head. The first auxiliary vacuum box includes an auxiliary region of reduced air pressure. The auxiliary vacuum box is adapted for applying reduced air pressure to the auxiliary contact means for application to the first edge of the running web. In some applications, the auxiliary contact means comprises two lips having a vacuum slot between the lips. In such applications, the lips are applied to the surface of the carrier fabric to pull a vacuum through the fabric, thereby adhering the running web to the carrier fabric.

A process also is provided for manufacturing paper from a web in a papermaking machine. The process includes applying a first suction force at a first point on the web, and a second suction force at a second point which is downstream from the first suction force. These forces, acting together, transfer the web from the first carrier fabric to a second carrier fabric. The second suction force is applied to the first and second edges of the web, thereby completing transfer the web from a first carrier fabric to a second carrier fabric.

Brief Description of the Drawings

A full and enabling disclosure of this invention, including the best mode shown to one of ordinary skill in the art, is set forth in this specification. The following Figures illustrate the invention:

Figure 1 is an overview of a portion of the apparatus employed to produce paper products such as tissue, paper toweling and the like from

a paper slurry;

Figure **2** reveals a closer side view of the vacuum apparatus employed in transferring a running web from a first carrier fabric to a second carrier fabric in the manufacture of web-based products;

Figure **3** shows a portion of an end view of the apparatus shown in Figure **2**, in which the first edge **46** of the running web **30** is shown in relation to the vacuum apparatus; and

Figure **4** is a machine directional view of the entire apparatus.

Detailed Description of the Invention

Reference now will be made to the embodiments of the invention, one or more examples of which are set forth below. Each example is provided by way of explanation of the invention, not as a limitation of the invention. In fact, it will be apparent to those skilled in the art that various modifications and variations can be made in this invention without departing from the scope or spirit of the invention. For instance, features illustrated or described as part of one embodiment can be used on another embodiment to yield a still further embodiment. Thus, it is intended that the present invention cover such modifications and variations as come within the scope of the appended claims and their equivalents. Other objects, features and aspects of the present invention are disclosed in or are obvious from the following detailed description. It is to be understood by one of ordinary skill in the art that the present discussion is a description of exemplary embodiments only, and is not

intended as limiting the broader aspects of the present invention, which broader aspects are embodied in the exemplary constructions.

The application of the invention of this application facilitates the use of relatively low transfer vacuum levels when using a pick-up shoe or vacuum box to transfer a web onto a highly topographical fabric. Many carrier fabrics used in uncreped through-air-dried ("UCTAD") processes provide a relatively high degree of topography on the surface of the fabric that contributes to the need for improved efficiency in the vacuum transfer process. The invention may assist in avoiding transfer difficulty, especially difficulty that occurs at the edges of the running web when an attempt is made to transfer at relatively low levels of vacuum. The application of the invention facilitates the use of lower levels of vacuum, which may result in a superior product, reduced energy costs, or more reliable production of product. The use of auxiliary pick-up boxes positioned at one or more edges of the running web facilitates a relatively clean and reliable transfer of the entire running web from one carrier fabric to another.

In papermaking, the term "machine direction", or "MD", refers to that direction which is parallel to the flow of the running paper web through the equipment. The "cross-direction", or "CD", is generally perpendicular to the machine direction and lies in the plane of the papermaking carrier fabric. The machine direction and cross direction

are indicated by arrows in several Figures of the application, described below.

Essentially any carrier fabric may be used in the application of the invention. Transfer of a running web typically occurs when centripetal acceleration or air pressure applied from a transfer head causes the web to move from one carrier fabric to another carrier fabric. The invention provides particular assistance when using carrier fabrics that have a topography or uneven feature on the surface of the carrier fabric. A fabric having a relatively high permeability to fluids such as water and air is typically used in the practice of the invention. Any papermaking belt suitable for use in a through-drying process, or UCTAD process, may be utilized in the practice of the invention. For example, papermaking belts such as those shown in United States Patent Nos. 4,529,480; 4,514,345; 4,637,859; and 5,334,289 may be employed in the practice of the invention. Topographical fabrics that may be employed in the practice of the invention may be supplied by various manufacturers such as Voith Fabrics, Asten, and others. Many types of fabric can be employed in the practice of the invention.

In some applications, it is possible to employ a pressure at the primary head of the vacuum box of no more than about 8.5 inches of Mercury. Furthermore, in still other applications it is possible to demonstrate transfer of a running web using a pressure of 4 inches of Mercury or less. It may be possible to use levels as low as 1 inch or less

of Mercury, depending upon the particular carrier fabric used and processing conditions.

Turning now to Figure **1**, a papermaking apparatus **11** is shown comprising a former **13**, which receives a paper slurry from headbox **12**. A sheet is formed as the former **13** proceeds in the machine direction **21** as shown in the right side of Figure **1**. Vacuum apparatus **15** transfers the sheet which is being formed (not shown) to the first carrier fabric **14**. Then, the running web proceeds along the direction arrow **23** to the vacuum apparatus **16**, which transfers the running web to a second carrier fabric **17**. The machine direction **22** is shown by reference to the arrow **29**. The dryer **18**, is the structure around which the second carrier fabric **17** travels in drying the running web. A dryer hood **19** is shown over the top portion of the dryer **18**. Finally, a product **20** emerging from the papermaking apparatus **11** as shown on the left side of Figure **1**.

In Figure **2**, the vacuum apparatus **16** of Figure **1** is shown in greater detail. The first carrier fabric **14** carries the running web **30** along the machine direction **28** to the transfer zone **35**. It is in the transfer zone **35** that the running web **30** is transferred from the first carrier fabric **14** to the second carrier fabric **17**. The transfer is accomplished by applying vacuum pressure or a suction force which moves the running web **30** from the surface of the first carrier fabric **14** and to the surface of the second carrier fabric **17**. A primary head **25** or primary contact means applies air pressure between a first lip **33** and a second lip **34**. In

Figure **2**, the "upstream" end of the process is indicated at **31**, and the "downstream" end of the process is indicated at **32**.

A primary vacuum box **27** having a region **26** of reduced air pressure is shown on the left side of Figure **2**. The reduced air pressure in region **26** is applied to the vacuum slot **42** which is located between the first lip **33** and the second lip **34**.

Further downstream from the primary head **25** is the auxiliary head **36**. The auxiliary head **36** assists in pulling by vacuum force, the edges of the running web **30** from the first carrier fabric **14** to the second carrier fabric **17** to effect a complete and reliable transfer. In some cases, the distance between the auxiliary head **36** and the primary head **25** is about 5 or 6 inches. However, in other applications of the invention it might be possible to provide such a distance which is less than one inch or as great as 1 or 2 feet, or even more.

An auxiliary vacuum box **37** is fluidly connected to the auxiliary head **36**. A vacuum supply tube inlet **38** is shown, having an auxiliary region **40** of reduced air pressure which is seen in Figure **2**. A mounting bracket **39** supports the auxiliary vacuum box **37**, and in this particular embodiment, connects it to the primary vacuum box **27** for support. Other mounting arrangements are possible in the practice of the invention. A portion of the dryer **18** may be seen in the upper left portion of Figure **2**.

If one observes the apparatus shown in Figure **2** from the right side, as if looking "through" the first carrier fabric **14**, one would see a view similar to that shown in Figure **3**. Thus, Figure **3** is an end view of the apparatus shown in Figure **2**. Figure **3** only shows, however, a portion of the apparatus of Figure **2**, and in particular it shows the first edge **46** of the running web **30**.

In Figure **3**, the running web **30** is moving from the bottom of Figure **3** towards the top of Figure **3**, along the pathway **29** of the running web **30**. Thus, the arrow indicated as pathway **29** is in the machine direction. The auxiliary vacuum box **37** is shown near the center of Figure **3**, and comprises first lip **47** and second lip **48** which are directly in contact with the underside of the running web **30**. Furthermore, the primary vacuum box **27** pulls air through a first auxiliary contact means such as a vacuum slot **42**, which is bounded by first lip **33** and second lip **34**, which extend essentially the full width of the running web **30**. In most applications, two separate auxiliary vacuum boxes **37** will be supplied, one on the first edge **46** of the running web **30**, and another on the second edge (not shown in Figure **3**) of the running web. The air flow or suction force applied through the running web **30** proceeds into the auxiliary vacuum box **37**, and moves along arrows **45a-c**, as shown in Figure **3**, from right to left in the Figure. The air moves along vacuum supply tube inlet **38**. The auxiliary region **40** of reduced air pressure is shown as well, and primary vacuum box **27** is shown in Figure **3** having

region **26** of reduced air pressure. The cross direction (CD) of the running web is shown extending from the left margin to the right margin of Figure **3**, as shown in cross directional arrow **49**.

The width of the vacuum slot **50** in the auxiliary head **36**, which is bounded by first lip **47** and first lip **48**, may be varied. Deckle strips (not shown) are usually employed upon the vacuum slot **50**. However, a slot width of about 0.75 inches is believed to be acceptable but could be as great as 4-6 inches or as little as 0.2 inches, depending upon the application. A width of between 0.5 and 1.5 inches is desirable. A length of the slot which corresponds to about 1 foot in the cross direction **49** may be used. However, there is no practical limit on the slot length, and the vacuum slot **50** could extend the entire width of the running web **30**, or instead be abbreviated to only a portion of the cross directional distance, as along the edge of running web **30**, as shown in Figures **3-4.** A slot length of between 6 inches and two feet is desirable.

The level of vacuum that must be employed to correctly and reliably transfer the running web **30**, while still avoiding damage to the running web **30**, will vary depending upon the particular application. However, it is believed that vacuum levels of about 6 inches of Mercury may be employed in some applications, while other applications may permit a reduced vacuum level of less than 6 inches, such as 4 inches or perhaps even as low as 2 inches, depending upon the fabric used and the processing conditions.

The region **26** of reduced air pressure and the auxiliary region **40** of reduced air pressure may be in fluid communication, and may be pumped to a vacuum using the same apparatus. However, depending upon the configuration, is also possible for these two regions to be separate, and not in fluid communication, and therefore capable of imparting differing pressure values concurrently. One means that could be employed to provide a pressure drop would be to use a valve or valve assembly (not shown).

In Figure **4**, a cross-directional width of the vacuum apparatus **16** is shown with both the left and right sides of the apparatus displayed. On the left side of Figure **4**, a vacuum supply tube inlet **38** is fluidly connected to the auxiliary vacuum box **37**. On the right side of Figure **4**, a vacuum supply tube inlet **60** is fluidly connected to the second auxiliary vacuum box **57**. A second auxiliary head **58** is connected to the second auxiliary vacuum box **57**, and is applied to the second edge **53** of the running web **30**. On the left side of Figure **4**, the auxiliary head **36** is applied to the first edge **46** of the running web, as previously shown in Figure **3**. Figure **4** also shows the auxiliary region of reduced air pressure **40** on the left side of the Figure, and the auxiliary region of reduced air pressure **59** within the vacuum supply tube inlet **60**. The first lip **33** and second lip **34** form the primary vacuum means which extends essentially the full width along the cross direction **61** of the running web (running web not shown in Figure **4**). Thus, the first lip **33** and second lip

34 are applied directly to the surface of the running web **30** (running web **30** not shown in Figure **4**) in applying a vacuum to the running web **30**. A vacuum slot **42** is located between the first lip **33** and the second lip **34**. A primary vacuum box **27** is shown which is in fluid connection with the first lip **33** and second lip **34** of the vacuum apparatus **16**.

It is understood by one of ordinary skill in the art that the present discussion is a description of exemplary embodiments only, and is not intended as limiting the broader aspects of the present invention, which broader aspects are embodied in the exemplary constructions. The invention is shown by example in the appended claims, but is not limited to the specific features recited in the claims.